

## CONSTRUCTION TECHNOLOGY: HVAC II

*Construction Technology: HVAC II* builds on concepts introduced in HVAC I. This course will emphasize reading blueprints and other technical documents, as well as troubleshooting common mechanical and electrical problems encountered when servicing HVAC systems. Additional topics include: combustion testing, venting and air requirements, electrical control systems, and electrical motor basics. Students will hone their science and math skills in HVAC system installation, maintenance, or repair projects.

- DOE Code: 5498
- Recommended Grade Level: Grade 12
- Recommended Prerequisites: Construction Technology: HVAC I
- Credits: 2-3 credits per semester, maximum of 6 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with postsecondary courses for Dual Credit:
  - Ivy Tech
    - HVAC 107 – Duct Fabrication/Installation
    - HVAC 208 – Heating Service
    - HVAC 211 – Refrigeration

### Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

### Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences. When a course is offered for multiple hours per semester, the amount of laboratory application or work-based learning needs to be increased proportionally.

### Career and Technical Student Organizations (CTSOs)

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in SkillsUSA, the CTSO for this area.

## Content Standards

### Domain – Duct Fabrication and Installation

**Core Standard 1** Students fabricate duct systems and fittings to install, maintain, and repair systems.

#### Standards

- HVACII-1.1 Develop layout drawings to scale
- HVACII-1.2 Interpret schedules, drawings and specifications shown on construction drawings to formulate a material list
- HVACII-1.3 Layout and calculate measurements for ductwork used in HVAC mechanical drawings

- HVACII-1.4 Demonstrate the use of hand tools and shop equipment used to fabricate sheet metal duct and fittings
- HVACII-1.5 Layout and fabricate sheet metal and fiberglass duct fittings such as plenums, transitions, and elbows
- HVACII-1.6 Demonstrate proper installation techniques of sheet metal, fiberglass, and flexible duct systems

### **Domain – HVAC System Design**

**Core Standard 2** Students apply and adapt HVAC installation processes to design projects.

#### **Standards**

- HVACII-2.1 Develop project plans to install properly sized HVAC equipment based on Manual J heat loss/gain load estimates
- HVACII-2.2 Develop project plans to install properly sized sheet metal, fiberglass, and flexible duct systems
- HVACII-2.3 Develop materials list and costs estimates for HVAC sales bid
- HVACII-2.4 Measure airflow through main and branch ducts using pressure and velocity instruments
- HVACII-2.5 Develop familiarity with manufacturer’s literature pertaining to product data

### **Domain – Heating Service**

**Core Standard 3** Students analyze heating systems to evaluate and maintain natural gas, propane, fuel oil, and electric heating appliances.

#### **Standards**

- HVACII-3.1 Develop familiarity with manufacturer’s literature pertaining to service data
- HVACII-3.2 Verify manufacturer’s specifications pertaining to temperature, electrical, and pressure data
- HVACII-3.3 Analyze the electrical schematic of heating appliances and demonstrate logic of operation
- HVACII-3.4 Discuss operational parameters of hot water and steam boiler systems
- HVACII-3.5 List basic code requirements pertaining to furnace installations
- HVACII-3.6 Describe different venting requirements from atmospheric to induced draft heating appliances
- HVACII-3.7 Formulate a “clean and check” preventative maintenance procedure for all heating appliances

### **Domain – Advanced Refrigeration**

**Core Standard 4** Students analyze refrigeration principles to accurately evaluate, assess, and troubleshoot maintenance problems.

#### **Standards**

- HVACII-4.1 Locate air conditioning, heat pump, and refrigeration system components normally found in residential and light commercial systems
- HVACII-4.2 Analyze common types of component failure and the effects each has on the performance of the system
- HVACII-4.3 Apply fundamentals of the refrigeration cycle to interpret and troubleshoot air conditioning, heat pump, and light commercial refrigeration systems
- HVACII-4.4 Outline the basics of residential and light commercial electrical systems including

- controls used in temperature, humidity, and zoning
- HVACII-4.5 Describe motor starting components, their applications, functions, and troubleshooting
  - HVACII-4.6 Analyze compressor failures and preventative measures to avoid compressor failures
  - HVACII-4.7 Describe and analyze the effects of evaporator and condense loads and how they affect system performance
  - HVACII-4.8 Develop familiarity with manufacturer's literature pertaining to service data
  - HVACII-4.9 Verify manufacturer's specifications pertaining to temperature, electrical, and pressure data
  - HVACII-4.10 Analyze the electrical schematic of cooling appliances and demonstrate logic of operation
  - HVACII-4.11 List basic code requirements pertaining to air conditioning, heat pump, and refrigeration installations
  - HVACII-4.12 Formulate a "clean and check" preventative maintenance procedure for all cooling appliances

### **Domain – Alternative Heating and Cooling**

**Core Standard 5** Students evaluate alternative and green energy methods to perform maintenance, repair, and troubleshooting procedures on heating and cooling systems.

#### **Standards**

- HVACII-5.1 Describe alternatives to residential heat sources including geothermal, solar, and outdoor fuel furnaces such as corn pellets and wood burners
- HVACII-5.2 Describe applications of geothermal ground loops including horizontal, vertical, and pond loops
- HVACII-5.3 Discuss applications of commercial and industrial cooling systems including process cooling systems and their applications
- HVACII-5.4 Describe alternative cooling methods such as ice storage and cryogenics

## **Process Standards**

### **Common Core Literacy Standards for Technical Subjects**

#### **Reading Standards for Literacy in Technical Subjects 11-12**

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

#### **Key Ideas and Details**

- 11-12.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- 11-12.RT.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- 11-12.RT.3 Follow precisely a complex multistep procedure when performing technical tasks; analyze the specific results based on explanations in the text.

### **Craft and Structure**

- 11-12.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 11-12 texts and topics*.
- 11-12.RT.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- 11-12.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

### **Integration of Knowledge and Idea**

- 11-12.RT.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- 11-12.RT.8 Evaluate the hypotheses, data, analysis, and conclusions in a technical subject, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- 11-12.RT.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

### **Range of Reading and Level of Text Complexity**

- 11-12.RT.10 By the end of grade 12, read and comprehend technical texts in the grades 11-CCR text complexity band independently and proficiently.

### **Writing Standards for Literacy in Technical Subjects 11-12**

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

#### **Text Types and Purposes**

- 11-12.WT.1 Write arguments focused on *discipline-specific content*.
- 11-12.WT.2 Write informative/explanatory texts, including technical processes.
- 11-12.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

#### **Production and Distribution of Writing**

- 11-12.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 11-12.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- 11-12.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments

or information.

**Research to Build and Present Knowledge**

- 11-12.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- 11-12.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation
- 11-12.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

**Range of Writing**

- 11-12.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.